APPARATUS FOR IMAGE FORMATION AND DEVELOPING MACHINE

Publication number: WO0107969
Publication date: 2001-02-01
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Classification:
- international: ***G03G15/09;*** **G03G15/09**; (IPC1-7): G03G15/09
- European: G03G15/09
Application number: WO1999JP03946 19990723
Priority number(s): WO1999JP03946 19990723

Also published as:

US6829452 (B2)
US2002061209 (A

Cited documents:

JP52050243
JP56099364
JP4264473
JP61027152U
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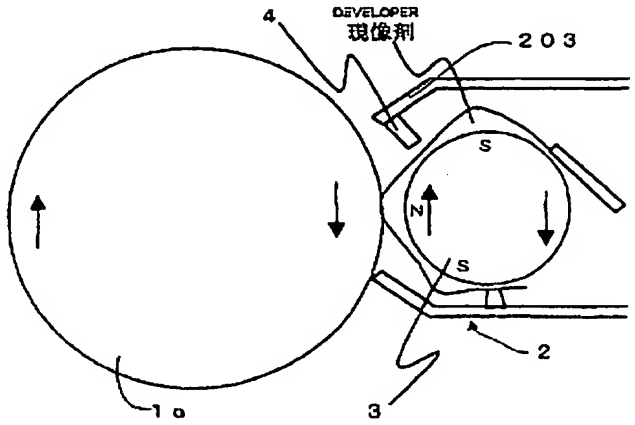
Abstract of **WO0107969**

A gap controller (4) provided toward a photosensitive drum (1) above a developer roller (3) controls a gap (L) so that it may be equal or smaller than the height of a magnetic brush, (T), in the magnetic pole immediately downstream from the location where the gap is adjusted. This minimizes scatter of the developer from a developing machine (2).



APPARATUS FOR IMAGE FORMATION AND DEVELOPING MACHINE

Description of corresponding document: Translate this text
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BACKGROUND OF THE INVENTION
[0001] 1. Field of the Invention
[0002] The present invention relates to an image forming apparatus and a developing device used in the image forming apparatus for copying machines, facsimile machines, printers and other information processing systems, which utilize an electrophotographic process wherein a visual image is produced on a photosensitive member by a developer by use of electrostatic attraction, and the visual image is transferrec to a sheet.
[0003] 2. Discussion of Background
[0004] In an image forming apparatus wherein a visual image is produced on a photosensitive member la by a developer, such as a toner, and the visual image is transferred onto a material for transfer, such as a sheet, conveyed along a conveyance path M as shown in FIG. 17, a developing unit 2 has a cover 203 provided, with a certain clearance, above a developing roller 3 for causing the developer to adhere to a latent image on the photosensitive member 1a as shown in FIG. 18.
[0005] When the rotational direction of the developing roller 3 in the developing unit 2 is set such that the developing roller rotates in a direction against gravity at a contacting point of the developing unit 2 with or a point of the developing unit closest to the photosensitive member 1a, air is introduced into the developing unit 2 through the clearance above the developing roller 3 by rotation of the developing roller 3 as shown in FIG. 18 to increase the air pressure in the developing unit 2, causing the air in the developing unit 2 to be discharged through a gap of the developing unit 2 or lateral gaps at both ends of the developing roller 3. Concomitantly, some part of the developer stored in the developing unit 2 blows out through these gaps, contaminating the interior of the apparatus or scattering the developer.
[0006] One of protection measures is that the clearance above the developing roller 3 is eliminated to prevent the inner pressure in the developing unit 2 from increasing. However, when the cover 203 is configured to have a leading edge put into contact with a surface of the photosensitive member 1a, the surface of the photosensitive member 1a is apt to be damaged by the leading edge, which is not desirable.
[0007] The present invention is proposed in consideration of the problems and provides an image forming apparatus capable of preventing a developer from scattering from a developing unit by preventing the air pressure in the developing unit from increasing without damaging a surface of a photosensitive member. Another object of the present invention is to provide a developing device capable of preventing a developer stored therein from scattering as well.

SUMMARY OF THE INVENTION
[0008] In order to attain an object, the present invention adopts an arrangement for regulating a clearance for a surface of a developer carrying member above the developer carrying member as stated later on. The present invention clarifies what extent of the clearance is effective, where a clearance regulated position should be located, to what extent a clearance regulated range is set, and what shape of a clearance regulating portion is preferable.
[0009] Specifically, the image forming apparatus according to the present invention is characterized in that the apparatus comprises:
[0010] a photosensitive member adapted to have an electrostatic latent image carried thereon;
[0011] a developing unit including a developer carrying member rotatable in a direction against gravity at a contacting point with or a point closest to the photosensitive member, and a cover for sealing a developer t be conveyed by the developer carrying member therein, the developer carrying member carrying and conveying the developer stored in the cover to develop the electrostatic latent image on the photosensitive member; and
[0012] a clearance regulating member provided so as to be free from contact with a surface of the developer carrying member, the clearance regulating member regulating a clearance for an upper side of the developer carrying member;
[0013] wherein the clearance between the developer carrying member and the clearance regulating member is determined at a size not greater than a maximum height of the developer projected from the surface of the developer carrying member.
[0014] In accordance with the present invention, the clearance for the surface of the developer carrying member above the developer carrying member can be regulated by the clearance regulating member to restrict supply of air into the developing unit and restrain an increase in the air pressure in the developing unit, thereby preventing the developer from scattering from the developing unit.
[0015] The developer carrying member may be configured to be a developing roller, a brush, a belt and so on. The developer carrying member may be configured in any fashion as long as it rotates, carrying the developer thereon.

[0016] With respect to the rotational direction of the developer carrying member 3a rotatable in the directior against gravity at the contacting point with or the point closest to the photosensitive member 1a, there are examples shown in FIGS. 19(a), (b), (c) and (d) with respect of combination of the developer carrying member 3a with the photosensitive member 1a In the case of the developing unit 2 having the developer carrying member 3a rotating in such a rotational direction, the developer is apt to scatter since air is introduced into the developing unit 2 by rotation of the developer carrying member 3a to increase the inner pressure in the developing unit 2 as stated earlier. In the present invention, the clearance regulating member prevents air from being introduced. The inventors have found on experiments stated later that there are significant differences according to the extent in regulation of the clearance, and the inventors have attained the present invention.

[0017] The inventors have conducted experiments to measure an amount of a scattered developer with respect to different regulating amounts (clearance size) L for regulating the clearance above the developinç roller 3 provided by the clearance regulating member 4 in the case of the developing unit 2 including a plurality of magnets in the developing roller 3 as shown in FIG. 1. The measurement of the amount of the scattered developer has been carried out by putting measurement members under both sides of the developing roller 3 and measuring the weight of the developer deposited on the measurement members. The measurement was carried out by rotating the developing roller 3 in the developing unit 2 in such a state that only the developing unit 2 was operated.

[0018] FIG. 2 shows the results of an experiment. As shown in this figure, the amount of a scattered developer drastically decreases at a clearance size L of 3.5 mm as a threshold. At this threshold, the magnetic brush of the developer which was located at a magnetic pole just downstream of a position regulated by the clearance regulating member in terms of rotation of the developing roller 3 had a height T of 3.5 mm.

[0019] A similar experiment, which was carried out with the magnetic force of the developing roller 3 modified, shows that the amount of a scattered developer drastically decreases at a clearance size L of 3.0 mm as a threshold. At this threshold, the magnetic brush of the developer which was located at a magnetic pole just downstream of the position regulated by the clearance regulating member in terms of rotation of the developing roller 3 had a height T of 3.0 mm.

[0020] Another similar experiment, which was carried out with the magnetic force of the developing roller 3 further modified, shows that the amount of a scattered developer drastically decreases at a regulated value as a threshold. This regulated value was a clearance size L of 3, 8 mm, and the magnetic brush of the developer which was located at a magnetic pole just downstream of the position regulated by the clearance regulating member in terms of rotation of the developing roller 3 had a height T of 3.8 mm.

[0021] In other words, it has been found that the scattering of the developer can be drastically decreased by determining the regulating amount L for regulating the clearance above the developer carrying member 3a at a size not greater than the height T of the magnetic brush of the developer which is located at a magnetic pole just downstream of a clearance regulated position in terms of rotation of the developer carrying member 3a. FIG. 3 shows graphs of the measured results of the clearance size L and the amount of the scattered developer in the heights T of the respective magnetic brushes in a single chart, and each of graphs shows that the amount of the scattered developer decreases at a point where the clearance size L is determined at a size not greater than the size equal to the height T of each of the magnetic brushes.

[0022] On the other hand, when the operation was carried out in such a state that the clearance regulating member 4 was provided so as to be in slight contact with a surface of the developing roller 3 as shown in FIG. 4, a developer accumulation D was produced between the photosensitive member 1a and the developer roller 3 as shown in this figure to deposit the developer on the photosensitive member 1a, providing an obstacle to printing. This means that the clearance regulating member 4 is required to be free from contact with the surface of the developer carrying member 3a.

[0023] The magnetic brush of the developer that was located at a magnetic pole just downstream of a clearance regulated position provided by the clearance regulating member in terms of rotation of the developer carrying member 3a is a projected portion of the developer, which projects from the surface of the developer carrying member 3a at the maximum height, and the portion that is determined at a size closest to the height T of that magnetic brush is a gap G between the developer carrying member 3a and the photosensitive member 1a

[0024] The inventors have also carried out research on correlation of the gap G between the developing roller 3 and the photosensitive member 1a with the clearance between the developing roller 3 and the clearance regulating member 4 with respect to the amount of a scattered developer. The research has showed that the gap G between the developing roller 3a and the photosensitive member 1a also has a certain correlation with the clearance regulating amount L with respect to the amount of the scattered developer. Specifically, by determining the clearance for the developer carrying member 3a provided by the clearance regulating member 4 at a size not greater than the gap G between the developer carrying member 3a and the photosensitive member 1a, it becomes possible to drastically decrease the amount of the scattered developer as in the cases shown in FIGS. 2 and 3.

[0025] Further, the inventors have examined where the arrangement for regulating the clearance for the surface of the developer carrying member 3a should be provided to effectively decrease the amount of a scattered developer, and the inventors has come to the following conclusion.

[0026] It has been found that when the developer carrying member 3a is configured to have magnetic poles, a position where the clearance is regulated by the clearance regulating member 4 can be located between a magnetic developing pole (an N pole in FIG. 5) and a magnetic pole (an S pole in the same figure) downstream of the magnetic developing pole as shown in FIG. 5 to decrease the amount of a scattered developer at the most effective fashion.
[0027] The reason why locating of the clearance regulating member at this position is that the distance between the surface of the developer and the clearance regulating member 4 is constant at this location since a developer storm caused by magnetic poles in the developer carrying member 3a has no influence to the thickness of the layer of the developer at this location. In other words, the developer is shown in some figures to build up at the maximum at the magnetic developing pole and its subsequent downstream magnetic pole, where the magnetic brushes are produced as stated earlier. Actually, rotation of a sleeve or the surface of the developing roller 3 causes the developer to repeatedly collapse and build-up at these positions, producing a developer storm. On the other hand, the build up of the developer caused by the magnetic poles is not produced at an intermediate position between the magnetic developing pole and the subsequent magnetic pole, where the developer keeps a constant thickness since even rotation of the sleeve has no effects on the thickness of the developer. From this viewpoint, the clearance between the clearance regulating member 4 and the developer carrying member 3a can be always constant by determining such an intermediate position as the clearance regulated position.
[0028] Although both magnetic poles are, respectively, an N pole and an S pole in the showned examples, both magnetic poles may reverse in polarity or be the same in polarity.
[0029] When the developer carrying member 3a has a plurality of magnetic poles provided in an upper portion thereof, the clearance regulated position provided by the clearance regulating member 4 may be located between a first magnetic and a second magnetic pole downstream of a magnetic developing pole ir terms of rotation of the developer carrying member 3a. For example, when the magnetic poles are providec so that a first magnetic pole as the magnetic developing pole is followed by a second magnetic pole and a third magnetic pole in the downstream direction of the first magnetic pole as shown in FIG. 6, the clearance regulated position may be located between the second magnetic pole and the third magnetic pole. This is because the distance between the surface of the developer and the clearance regulating member 4 can be kept constant at this location as well since a developer storm caused by magnetic poles in the developer carrying member 3a has no influence to the thickness of the layer of the developer at this location as statec earlier.
[0030] It is preferable that the mounting location of the clearance regulating member 4 is determined on a side remote from the photosensitive member 1a with respect to a line connecting the leading edge of the clearance regulating member 4 and the center of the developer carrying member 3a as shown in FIG. 7. By mounting at this location, deformation, such as bending, can be applied to the clearance regulating membe 4. Even if the clearance regulating member 4 per se does not have high rigidity, the deformation can be applied to the clearance regulating member to increase the rigidity of the clearance regulating member. As a result, the clearance regulating member can carry out stable clearance regulation, which is quite effective to reduce the scattering of the developer.
[0031] Next, the inventors have examined how wide the range where the clearance is regulated by the clearance regulating member should be, and the inventors have come to the conclusion that a regulating width W1 for the clearance above the developer carrying member 3a needs to be determined at a size not smaller than a developing width W2 on the developer carrying member 3a as shown in FIG. 8. This is because when the clearance regulating member 4 has such a determined width, both ends of the developing width W2 on the developer carrying member 3a, where the scattering amount of the developer becomes the greatest, can be regulated by the clearance regulating member, thereby effectively restraining the developer from scattering.
[0032] In addition, the inventors have examined what is a preferable shape for the portion where the clearance is regulated by the clearance regulating member. In conclusion, when a cover 203 of the developing unit tends to become closer to a central portion of the developer carrying member 3a in terms o shape due to, e.g., deformation affected by heat, it is preferable that the leading edge of the clearance regulating member is formed so as to have a greater original clearance at a central portion than portions adjacent to both ends of the developer carrying member 3a as shown in FIG. 9 for compensating deformation. Thus, the clearance regulation can be provided in stable fashion, and the developer can be effectively restrained from scattering.
[0033] Conversely, when the cover 203 of the developing unit tends to become away from a central portion of the developer carrying member 3a in terms of shape due to deformation, it is preferable in conclusion that the leading edge of the clearance regulating member is formed so as to have a smaller original clearance at the central portion than the portions close to both ends of the developer carrying member 3a as shown in FIG. 10. Thus, it becomes possible to compensate deformation. The clearance regulation can be provided in stable fashion, and the developer can be effectively restrained from scattering.
[0034] The present invention provides not only the arrangement of the image forming apparatus but also the arrangement of a developing device as stated earlier. Specifically the developing device is characterized in that the device comprises a developer carrying member rotatable in a direction against gravity at a contacting point with or a point closest to a photosensitive member adapted to have an

electrostatic latent image carried thereon, and a cover for sealing a developer to be conveyed by the developer carrying member in the cover, the developer carrying member carrying and conveying the developer stored therein to develop the electrostatic latent image on the photosensitive member; and the device further comprises at least a clearance regulating member provided so as to be free from contact witl a surface of the developer carrying member, the clearance regulating member regulating a clearance for ar upper side of the developer carrying member; wherein the clearance between the developer carrying member and the clearance regulating member is determined at a size not greater than a maximum height of the developer projected from the surface of the developer carrying member. This arrangement corresponds to the arrangement recited in claim 1.

[0035] When the developer carrying member is configured to have magnetic poles, it is preferable that the clearance for the developer carrying member provided by the clearance regulating member is determined at a size not greater than a height of a magnetic brush of the developer at a magnetic pole just downstrean of a clearance regulated position in terms of rotation of the developer carrying member. This arrangement corresponds to the arrangement defined in claim 2.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] FIG. 1 is a schematic diagram showing how a developing roller and a clearance regulating member are provided according to the present invention;

[0037] FIG. 2 is a graph showing correlation between an amount of a scattered developer and a clearance regulating amount;

[0038] FIG. 3 is graphs showing the measured results of an amount of a scattered developer and a clearance size in heights of respective magnetic brushes in a single chart;

[0039] FIG. 4 is a schematic diagram showing a state wherein the clearance regulating member is providec so as to be in slight contact with a surface of a developing roller;

[0040] FIG. 5 is a schematic diagram showing a state wherein a clearance regulated position is determined between a magnetic developing pole and its downstream magnetic pole;

[0041] FIG. 6 is a schematic diagram showing a state wherein when magnetic poles are provided so that a first magnetic pole as a magnetic developing pole is followed by a second magnetic pole and a third magnetic pole in the downstream direction of the first magnetic pole, the clearance regulated position is located between the second magnetic pole and the third magnetic pole;

[0042] FIG. 7 is a schematic view showing an arrangement wherein the mounting location of the clearance regulating member 4 is determined on a side remote from a photosensitive member 1 with respect to a line connecting a leading edge of the clearance regulating member 4 and the center of a developer carrying member 3a;

[0043] FIG. 8 is a schematic view showing a state wherein a regulating with W1 for a clearance above a developer carrying member 3a is determined at a size not smaller than a developing width W2 on the developer carrying member;

[0044] FIG. 9 is a schematic view showing an arrangement wherein the leading edge of the clearance regulating member is formed so as to have a greater original clearance at a central position than portions adjacent to both ends of the developer carrying member;

[0045] FIG. 10 is a schematic view showing an arrangement wherein the leading edge of the clearance regulating member is formed so as to have a smaller original clearance at the central portion than the portions adjacent to both ends of the developer carrying member;

[0046] FIG. 11 is a schematic view of the printer according to an embodiment of the present invention;

[0047] FIG. 12 is a perspective view of a developing unit 2;

[0048] FIG. 13 is a schematic diagram showing a state wherein developing treatment is carried out betweer the developing unit 2 and a photosensitive drum 1;

[0049] FIG. 14 is a schematic diagram showing how the developing roller 3 and the developing unit cover 203 thereabove are provided in the conventional arrangement;

[0050] FIG. 15 is a schematic diagram showing another embodiment of the present invention wherein the clearance regulating member 4 is formed from the developing unit cover 203;

[0051] FIG. 16 is a schematic diagram showing a state wherein the clearance regulating member 4 and the developing unit cover 203 are made of the same material;

[0052] FIG. 17 is a schematic view of the arrangement of an image forming apparatus wherein a visual image formed on a photosensitive member is transferred onto a conveyed sheet and so on;

[0053] FIG. 18 is a perspective view showing how a developer carrying member of the developing unit and a lid thereabove are provided; and

[0054] FIG. 19 is schematic diagrams showing examples of combination of the photosensitive member with the developer carrying member rotatable in a direction against gravity at a contacting point with or a point closest to the photosensitive member.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0055] Now, embodiments of the present invention will be described along with shown examples.

[0056] FIG. 11 is a schematic view of the arrangement of a printer with an electrophotographic process as an embodiment of the present invention. In this Figure, reference numeral 1 designates a photosensitive drum, reference numeral 2 designates a developing unit, reference numeral 3 designates a developing roller provided in the developing unit, reference numeral 101 designates a corona charger for providing charges with the photosensitive drum 1 to charge the drum, reference numeral 102 designates an LED head for carrying out exposure for forming a latent image, reference numeral 103 designates a transfer unit wherein an image on the photosensitive drum 1 that is developed to be visualized is transferred onto a sheet, and reference numeral 104 designates a cleaning unit for removing and collecting a residual developer on the photosensitive drum 1. In this figure, a symbol M designates a sheet conveyance path.
[0057] The photosensitive drum 1 rotates in the clockwise direction on this Figure. The corona charger 101, which is provided above the photosensitive drum 1, charges a drum surface. The LED head 102 carries out exposure to form an electrostatic latent image. Then, the developing roller 3 of the developing unit 2 causes a developer to adhere to the electrostatic latent image to form a visual image. After that, in the transfer unit 103, the visual image on the photosensitive drum 1 is transferred onto a sheet, which is conveyed by the conveyance path M in a direction indicated by an arrow in this figure. A portion of the developer that has not been transferred onto the sheet at that time is removed and collected by the cleaning unit 104.
[0058] FIG. 12 is a perspective view of the developing unit 2, and FIG. 13 is a schematic diagram showing a state wherein exposure treatment is carried out between the developing unit 2 and the photosensitive drum 1. In the shown example, the photosensitive drum 1 and the developing roller 3 are both rotating in the clockwise direction. Referring to FIG. 13, the developer, which has been stored in the developing unit 2 and has been charged by stirring therein, is conveyed from a lower right side by the developing roller 3, and a conveyance amount of the developer is regulated to a certain extent by a developer regulating blade 201. Further, the developer is conveyed to the photosensitive drum 1 by the developing roller 3. The latent image portion on the photosensitive drum 1, which is used for printing an image or a letter, has the developer deposited thereon, and the latent image is developed at that time. A portion of the developer that has not been used for developing is further conveyed by the developing roller 3 and is scraped from the developing roller 3 by a developer collecting blade 202. The developer thus scraped is mixed with the developer stored in the developing unit 2, and the mixture is stirred to be charged. This process is repeated to carry out image formation on the photosensitive drum 1.
[0059] A portion of developing roller 3 appears from such a type of developing unit 2, and the remaining portion of the developing roller are covered by resin covers 203. Although the covers 203 forming the respective sides are connected each other, the covers cannot provide a complete seal for a reason in manufacture. Between upper and lower portions of the developing roller 3 and corresponding covers 203, clearances are required so that the developing roller 3 can rotates without hindrance.
[0060] In a conventional arrangement, the distance between the developing roller 3 and the cover 203 of the developing unit 2 above the developing roller is relatively great as shown in FIG. 14. On the other hand, in accordance with the arrangement of the present invention, a clearance regulating member 4 is provided at a position above the developing roller 3 on a side close to the photosensitive drum 1 to regulate the clearance between the developing roller 3 and the clearance regulating member 4 as shown in FIG. 13.
[0061] The regulating amount L of the clearance is determined to be smaller than the height T of the magnetic brush at a magnetic pole located just downstream of the clearance regulated position based on the experimental results stated earlier. In this example, the height T of the magnetic brush is 3.5 mm while the clearance regulating member 4 has a leading edge determined so that the clearance between the leading edge of the clearance regulating member 4 and the developing roller 3 is smaller than 3.5 mm. Thus, the amount of a scattered developer is drastically reduced as shown in FIG. 2, and the scattering amount is significantly decreased in comparison with conventional apparatuses shown in FIG. 14. In the case of a conventional apparatus, the clearance between the cover 203 and the developing roller 3 is greater than 3.5 mm. The distance between the developing roller 3 and the photosensitive drum 1 is 3.5 mm. The thickness of a developer layer at this clearance regulated position is 1.5 mm, and the clearance size is determined so as to be greater than 1.5 mm. This is because a developer is prevented from adhering to a surface of the photosensitive drum 1 for avoiding an obstacle to printing on the ground of that when the leading edge of the clearance regulating member 4 gets in contact with the developer, the developer accumulation D is produced as stated earlier.
[0062] In this embodiment, the clearance regulating member is located so that the leading edge of the clearance regulating member 4 is located between an N pole as the magnetic developing pole of the developing roller 3 and an S pole as a magnetic pole downstream of the magnetic developing pole in terms of rotation of the developing roller 3 as shown in FIG. 13. As stated earlier, the distance between the surface of the developer and the clearance regulating member 4 is constant at this location since a developer storm caused by magnetic poles in the developing roller 3 has no influence to the thickness of the layer of the developer at this location. From this viewpoint, this location is the optimum location to regulate the clearance for preventing air from entering the developing unit 2.
[0063] When magnetic poles are provided so that a first magnetic pole as the magnetic developing pole is followed by a second magnetic pole and a third magnetic pole in the downstream direction of the first magnetic pole as shown in FIG. 6, the clearance regulated position provided by the clearance regulating member 4 may be located between the second magnetic pole and the third magnetic pole. This is because

the distance between the surface of the developer and the clearance regulating member 4 can be kept constant at this location as well since a developer storm caused by magnetic poles in the developing roller 3 has no influence to the thickness of the layer of the developer at this location as stated earlier.

[0064] FIG. 15 shows another embodiment according to the present invention. As shown in this Figure, the clearance regulating member 4 is formed from a cover 203 of the developing unit 2. Specifically, the cover 203 has a leading edge projecting toward the developing roller 3. This arrangement can restrain the clearance regulating member 4 from being deformed, which can not be overcome by a method to provide the cover 203 with the clearance regulating member 4 as a separate part. Thus, the cover 203 of the developing unit can have required rigidity as a whole, which leads to establishing of stable clearance regulation and to great contribution to a reduction in the scattered developer.

[0065] As another arrangement similar in principle to that shown in FIG. 15, the clearance regulating member 4 and the cover 203 of the developing unit may be made of the same material to restrain the clearance regulating member 4 from being deformed as shown in FIG. 16. By forming both members from the same material, the clearance regulating member 4 can be restrained from being deformed, and stable clearance regulation can be provided, which leads to contribution to a reduction in the scattered developer. This arrangement gives particularly significance against affection by environment. If both members are made of different materials, putting or using both members repeatedly at a low temperature and at a high temperature causes both members to be deformed by gradual build-up of stress due to a difference in contractility. This arrangement and the arrangement shown in FIG. 15 are appropriate to avoid such deformation.

[0066] When the cover 203 is likely to be greatly deformed, the deformation can be restrained by forming the clearance regulating member 4 and the cover 203 for the developing unit from different material in some cases. Specifically, when the cover 203 is likely to be greatly deformed, a cover 203 having a low deformation ratio can be employed to become useful in compensation to the deformation of the cover 203 for the developing unit. Thus, stable clearance regulation can be attained, and the developer can be effectively restrained from scattering.

[0067] When the clearance regulating member is made of a material different from the cover, it becomes easy to mount the clearance regulating member to the cover 203 of the developing unit and to adjust the mounting position and the mounting state of the clearance regulating member by forming the clearance regulating member from, e.g., a Mylar sheet as a flexible material. Of course, the cover 203 of the developing unit may be also formed from a Mylar sheet, which is the similar material as the clearance regulating member 4.

[0068] The clearance regulating member 4 may be formed from a material having high rigidity, such as SUS, which is different from the material forming the cover 203. When the clearance regulating member is formed from a material having high rigidity, such as SUS, the clearance regulating member can provide stable clearance regulation without being affected by deformation caused in the cover 203 of the developing unit. This arrangement is quite effective in a reduction in a scattered developer. Of course, the cover 203 of the developing unit may be formed from a material having high rigidity, such as SUS, as in the clearance regulating member 4.

[0069] When the clearance regulating member 4 is mounted so that the mounting location of the clearance regulating member 4 is determined on a side remote from the photosensitive drum 1 with respect to a line connecting the leading edge of the clearance regulating member 4 and the center of the developer roller 3 as shown in FIG. 7, the clearance regulating member 4 is allowed to be formed in, e.g., a dogleg shape or an L-character shape as shown in this figure. Even if the clearance regulating member 4 per se does not have high rigidity, this arrangement can increase the rigidity of the clearance regulating member. The clearance regulating member can provide stable clearance regulation as in the case of utilizing a material having high rigidity, such as SUS. This arrangement is quite effective to reduce the scattering of the developer.

[0070] In addition, the regulating width W1 for the clearance above the developing roller 3 is determined to be a size not smaller than the developing width W2 on the developing roller 3 as shown in FIG. 8. This is because the amount of a scattered developer becomes great at both ends of the developing width W2 on the developing roller 3, and because the clearance regulating member can provide both ends with regulation to reduce the scattering of the developer. From this viewpoint, this arrangement is commonly applicable to all embodiments stated earlier.

[0071] In addition, the leading edge of the clearance regulating member 4, which regulates the clearance size above the developing roller, needs to be formed so as to have a greater original clearance at a central portion than portions close to both ends of the developing roller 3 as shown in FIG. 9 in some cases. This measure is provided in consideration of deformation in the cover 203 of the developing unit due to influence by heat. In other words, when the cover 203 of the developing unit tends to become closer to the central portion of the developing roller 3 due to deformation, such an arrangement is adopted to establish stable clearance regulation and to effectively restrain the developer from scattering.

[0072] The leading edge of the clearance regulating member may be designed to be formed so as to have a smaller original clearance at the central portion as shown in FIG. 10. This measure is also provided in consideration of deformation in the cover 203 of the developing unit due to influence by heat. Specifically, when the cover 203 of the developer unit tends to become away from the central portion of the developing

roller 3 in terms of shape, this measure is adopted to establish stable clearance regulation and to effectively restrain the developer from scattering.

[0073] The arrangement of FIG. 9 and the arrangement of FIG. 10 are provided in consideration of the presence of contrary deformation in the cover 203 of the developing unit. Both arrangements are adopted when deformation becomes great due to influence by, e.g. heat. Since anisotropy is caused in some materials in terms of tensile strength and so on, it is necessary to select one of the arrangements after checking in which direction the deformation becomes significant.

[0074] The image forming apparatus according to the present invention is not limited to only the embodiments stated earlier. Variations and modifications are possible without departing the spirit of the invention.

[0075] As explained, when the clearance regulating member, which can regulate the clearance for the surface of the developer carrying member, is provided above the developer carrying member in accordance with the arrangement of the image forming apparatus of the present invention, an unknown clearance regulating size can be provided in the certain range, offering an advantage in that the scattering of the developer from the developing unit is extremely reduced.

[0076] Addition, in order to reduce the scattering of the developer, it is effective that the position where the clearance is regulated by the clearance regulating member is located between the magnetic developing pole and the magnetic pole downstream of the magnetic developing pole in terms of rotation of the developer carrying member. This is because the clearance regulation is carried out at the location where the distance between the surface of the developer and the clearance regulating member is constant due to the absence of influence by a developer storm.

[0077] Further, when the regulating width, which is provided by the clearance regulating member for the clearance above the developer carrying member, is determined at a size not smaller than the developing width on the developer carrying member, the clearance regulating member can regulate both ends of the developing width on the developer carrying member where the amount of the scattering developer is the greatest. It becomes possible to effectively prevent the developer from scattering.

[0078] As explained, the image forming apparatus and the developing device according to the present invention are effective as arrangements to prevent a developer from scattering in an apparatus for forming an image, such as copying machines, facsimile machines, printers and other information processing systems. The image forming apparatus and the developing device are appropriate to prevent the entrance of air into the developing unit, which has created the problem particularly in the case wherein the developer carrying member in the developing unit rotates in a direction against gravity at a contacting point with or a point closest to the photosensitive member.

APPARATUS FOR IMAGE FORMATION AND DEVELOPING MACHINE

Claims of corresponding document: Translate this text
US2002061209

What is claimed is:

1. An image forming apparatus comprising:
a photosensitive member adapted to have an electrostatic latent image carried thereon;
a developing unit including a developer carrying member rotatable in a direction against gravity at a contacting point with or a point closest to the photosensitive member, and a cover for sealing a developer t be conveyed by the developer carrying member therein, the developer carrying member carrying and conveying the developer stored in the cover to develop the electrostatic latent image on the photosensitive member; and
a clearance regulating member provided so as to be free from contact with a surface of the developer carrying member, the clearance regulating member regulating a clearance for an upper side of the developer carrying member;
wherein the clearance between the developer carrying member and the clearance regulating member is determined at a size not greater than a maximum height of the developer projected from the surface of the developer carrying member.

2. The image forming apparatus according to claim 1, wherein when the developer carrying member is configured to have magnetic poles, the clearance for the developer carrying member provided by the clearance regulating member is determined at a size not greater than a height of a magnetic brush of the developer at a magnetic pole just downstream of a clearance regulated position in terms of rotation of the developer carrying member.

3. The image forming apparatus according to claim 1, wherein the clearance for the developer carrying member provided by the clearance regulating member is determined at a size not greater than a gap between the developer carrying member and the photosensitive member.

4. The image forming apparatus according to claim 1, wherein when the developer carrying member is configured to have magnetic poles, a position where the clearance is regulated by the clearance regulating member is located between a magnetic developing pole and a magnetic pole downstream of the magnetic developing pole in terms of rotation of the developer carrying member.

5. The image forming apparatus according to claim 1, wherein the clearance for the upper side of the developer carrying member provided by the clearance regulating member has a width not smaller than a developing width on the developer carrying member.

6. A developing device comprising a developer carrying member rotatable in a direction against gravity at a contacting point with or a point closest to a photosensitive member adapted to have an electrostatic latent image carried thereon, and a cover for sealing a developer to be conveyed by the developer carrying member in the cover, the developer carrying member carrying and conveying the developer stored therein to develop the electrostatic latent image on the photosensitive member; and further comprising at least a clearance regulating member provided so as to be free from contact with a surface of the developer carrying member, the clearance regulating member regulating a clearance for an upper side of the developer carrying member; wherein the clearance between the developer carrying member and the clearance regulating member is determined at a size not greater than a maximum height of the developer projected from the surface of the developer carrying member.

7. The developing device according to claim 6, wherein when the developer carrying member is configured to have magnetic poles, the clearance for the developer carrying member provided by the clearance regulating member is determined at a size not greater than a height of a magnetic brush of the developer a a magnetic pole just downstream of a clearance regulated position in terms of rotation of the developer carrying member.

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(12)特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局

(43) 国際公開日
2001年2月1日 (01.02.2001)

PCT

(10) 国際公開番号
WO 01/07969 A1

(51) 国際特許分類[6]: G03G 15/09

(21) 国際出願番号: PCT/JP99/03946

(22) 国際出願日: 1999年7月23日 (23.07.1999)

(25) 国際出願の言語: 日本語

(26) 国際公開の言語: 日本語

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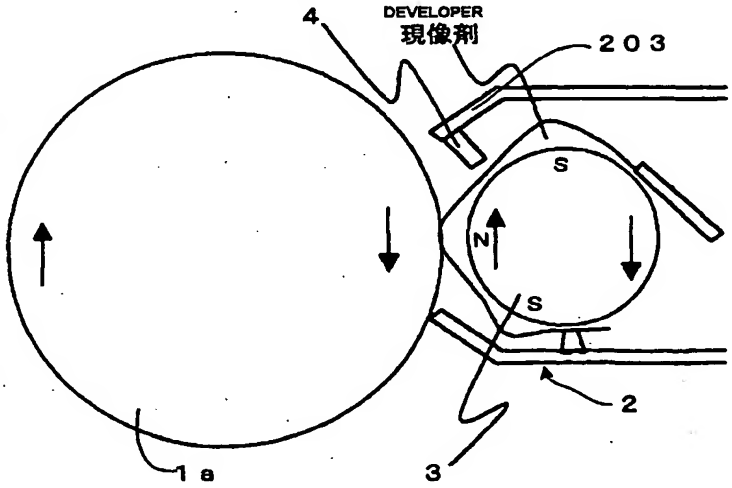
(81) 指定国 (国内): JP, US.

添付公開書類:
— 国際調査報告書

２文字コード及び他の略語については、定期発行される各PCTガゼットの巻頭に掲載されている「コードと略語のガイダンスノート」を参照。

(54) Title: APPARATUS FOR IMAGE FORMATION AND DEVELOPING MACHINE

(54) 発明の名称: 画像形成装置及び現像装置



(57) Abstract: A gap controller (4) provided toward a photosensitive drum (1) above a developer roller (3) controls a gap (L) so that it may be equal or smaller than the height of a magnetic brush, (T), in the magnetic pole immediately downstream from the location where the gap is adjusted. This minimizes scatter of the developer from a developing machine (2).

(57) 要約:

現像ローラ３上部の感光ドラム１寄りの方に設けられた隙間規制部材４による隙間規制量Ｌを、その隙間規制箇所より下流側直後にある磁極での磁気ブラシ高さＴ以下になるように設定する。それにより、現像器２からの現像剤の飛散が極めて低くなる。

WO 01/07969 A1

明　細　書

画像形成装置及び現像装置

技術分野

本発明は、静電引力により、感光体上に、現像剤による可視像を形成し、該像を用紙に転写する、電子写真方式を用いた、複写機、ファクシミリ、プリンタ、その他の情報処理システムなどの画像形成装置及び該画像形成装置に使用される現像装置に関する。

背景技術

第１７図に示すように、感光体１ａ上に、トナーなどの現像剤による可視像を形成して、その可視像を、搬送路Ｍを搬送されてきた用紙などの転写材に転写する画像形成装置では、第１８図に示すように、現像器２の部分で、前記感光体１ａ上の潜像に現像剤を付着させる現像ローラ３の上方に、所定の間隔を開けてカバー２０３が設けられている。

このうち、現像ローラ３の回転方向が、現像器２と感光体１ａの接点又は最接近点において、重力に逆らう方向に回転する現像器２の場合、該現像ローラ３の回転により、前記第１８図に示すように、現像ローラ３の上の隙間から現像器２内へ空気が送り込まれ、現像器２内の空気圧が増加し、現像器２の隙間や現像ローラ３両端の隙間から、内部の空気が排出される。それに伴って、現像器２内に溜まっている現像剤が同じ場所から吹き出し、装置内汚れや現像剤飛散を起こしていた。

これを防ぐ１つの方法としては、現像ローラ３上方の隙間をなくしてしまい、現像器２の内圧を高めないようにすることである。しかし、上記カバー２０３の先端部分を、感光体１ａ表面に接触させるような構成を用いると、該先端部による感光体１ａ表面の損傷をまねき易く、望ましいことではない。

本発明は、以上のような問題に鑑み創案されたもので、感光体表面の損傷をま

ねくことなく、現像器内の空気圧の増加を防止して、現像器からの現像剤の飛散を有効に防ぐことができる画像形成装置を提供せんとするものである。また本発明の他の目的は、内部に溜まった現像剤の飛散を防止できる現像装置についても、合わせて提案するものである。

発明の開示

以上の目的を達成するため、本発明は、以下に示すように、現像剤担持体上方に、該現像剤担持体表面との間にできる隙間を規制する構成を採用しているが、この隙間をどの程度にしたら効果的か、またどこにそのような隙間を規制する場所を設定したら良いか、さらにその隙間を規制する範囲をどの程度にすべきか、或いはその隙間を規制する部分の形状はどのようにしたら望ましいのかを明らかにしている。

すなわち、本発明の画像形成装置は、

静電潜像を担持している感光体と、

前記感光体との接点又は最接近点で重力に逆らう方向に回転する現像剤担持体と、該現像剤担持体により搬送される現像剤を封入するためのカバーとを備えていて、内部に溜まった現像剤を該現像剤担持体により担持し搬送して、前記感光体上の静電潜像を現像する現像手段と、

現像剤担持体表面に接触しないように設置され、該現像剤担持体上部側隙間を規制する隙間規制部材とを少なくとも有しており、

該現像剤担持体と隙間規制部材との隙間を、感光体との接点又は最接近点付近における、現像剤担持体表面より最も高く突出する現像剤の高さ以下に設定することを特徴としている。

上記構成によれば、現像剤担持体上方に、該現像剤担持体表面との間にできる隙間を、隙間規制部材により規制しているため、現像器内へ空気の送給が制限され、現像器内の空気圧の増加が抑えられて、現像器からの現像剤の飛散を有効に防ぐことができるようになる。

上記現像剤担持体には、現像ローラの構成の他、ブラシ構成のものやベルトな

どの構成のものであっても良く、現像剤を担持しながら回転するものであれば、どのような構成のものであっても構わない。

感光体１ａとの接点又は最接近点で重力に逆らう方向に回転する上記の現像剤担持体３ａの回転方向については、感光体１ａと現像剤担持体３ａとの組み合わせで、第１９図(ａ)(ｂ)(ｃ)(ｄ)に示すような例がある。以上のような回転方向となる現像剤担持体３ａを有する現像器２の構成では、上述のように、該現像剤担持体３ａの回転により、現像器２内に空気が送り込まれてしまい、現像器２の内圧が上昇して、現像剤の飛散が起こり易い。上記構成では、隙間規制部材により、このような空気の吸い込みを阻止するのであるが、後述する実験から、本発明者等は、その隙間の規制の程度によって、その効果に大きな差があることに気付き、上記本発明を完成させたものである。

本発明者等は、現像ローラ３内に複数のマグネットを有する現像器２の構成で、第１図に示すように、隙間規制部材４による現像ローラ３上部の隙間を規制する規制量Ｌ（隙間幅）を変更し、現像剤の飛散量を測定する実験を行った。この現像剤飛散量の測定は、現像ローラ３両側の下に、測定部材を置き、そこに積もった現像剤重量を測定することで行った。この時現像器２は、該現像器２単体で、現像ローラ３を回転させることで行った。

第２図はこの時の実験結果を示すものである。同図に示すように、隙間幅Ｌ３．５ｍｍを境に、現像剤飛散量が極端に低減している。この時、隙間規制部材４によって隙間が規制される箇所から現像ローラ３回転下流側直後にある磁極での現像剤の磁気ブラシの高さＴは、３．５ｍｍであった。

次に現像ローラ３の磁力を変更した状態で、同様な実験を行ったところ、隙間幅Ｌ３．０ｍｍを境に、現像剤飛散量が極端に低減している。この時、隙間が規制される箇所から現像ローラ３回転下流側直後にある磁極での現像剤の磁気ブラシの高さＴは、３．０ｍｍであった。

さらに現像剤を変更した状態で、同様な実験を行ったところ、また或る規制値を境に現像剤飛散量が極端に低減した。この時の隙間幅Ｌは、３．８ｍｍで、隙間が規制される箇所から現像ローラ３回転下流側直後にある磁極での現像剤の磁気ブラシの高さＴは、３．８ｍｍであった。

すなわち、現像剤担持体３ａ上部の隙間を規制する規制量Ｌを、その隙間が規制される箇所から現像剤担持体３ａ回転下流側直後にある磁極での現像剤の磁気ブラシの高さＴ以下にすることで、現像剤飛散が飛躍的に低減させることができることが分かった。第３図は、各磁気ブラシの高さＴ毎に、隙間幅Ｌと現像剤飛散量の測定結果とをまとめたグラフであるが、いずれも、隙間幅Ｌを、夫々の磁気ブラシの高さＴと同じ幅だけ設定した点より、それ以下の方で、現像剤飛散量が減少していることが分かる。

一方第４図のように、隙間規制部材４を現像ローラ３表面にわずかに接触するように設置し、動作させたところ、同図に示すように、感光体１ａと現像ローラ３との間に、現像剤溜まりＤができ、感光体１ａに現像剤が付着し、印字障害となった。これにより、隙間規制部材４は、現像剤担持体３ａ表面に接触しないように設定する必要がある。

また隙間規制部材４によって隙間が規制される箇所から現像剤担持体３ａ回転下流側直後にある磁極での現像剤の磁気ブラシ部分は、現像剤担持体３ａ表面より最も高く現像剤が突出する部分であるが、その磁気ブラシ部分の高さＴに最も近い幅に設定されているのが、現像剤担持体３ａと感光体１ａとのギャップＧである。

本発明者等は、同様に、現像ローラ３・感光体１ａ間のギャップＧと、現像ローラ３・隙間規制部材４間の隙間との、現像剤飛散量に関する相関関係を調べた。そうしたところ、現像ローラ３と感光体１ａとのギャップＧに関しても、上記隙間規制量Ｌとの間に、現像剤飛散量に関して、一定の関係があることが分かった。すなわち、隙間規制部材４による現像剤担持体３ａとの隙間を、現像剤担持体３ａと感光体１ａとのギャップＧ以下に設定することで、第２図や第３図に示すと同様に、現像剤飛散量を飛躍的に減少させることができるようになる。

さらに、本発明者等は、現像剤担持体３ａ表面との間にできる隙間を規制する構成をどのような場所に設定したら、現像剤飛散量の低減に有効かを検討したところ次のような結論に至った。

すなわち、現像剤担持体３ａが磁極を有する構成である場合に、第５図に示すように、隙間規制部材４により隙間が規制される箇所が、現像磁極（図ではＮ極

）と、その現像磁極より現像剤担持体回転下流側の磁極（図ではＳ極）の間にあるように設定することで、現像剤飛散量の低減に最も効果的であることが分かった。

この隙間規制箇所が効果的であるのは、該隙間規制箇所での現像剤の層の厚さに、現像剤担持体３ａの磁極による現像剤の暴れの影響がなく、現像剤表面と隙間規制部材４の間隔が一定になっているからである。すなわち、図面では、現像磁極とその下流側の磁極のところで、現像剤が最も高く盛り上がっていることが示されているが、この部分は、前述のように、磁気ブラシが形成される箇所であり、実際には、現像ローラ３表面のスリーブが回転することで、その部分の現像剤の崩れや盛り上がりが繰り返され、現像剤の暴れが生じている。これに対し、その間の部分では、以上の磁極による現像剤の盛り上がりがなく、スリーブの回転があっても、現像剤の厚さに影響がなく、一定の厚さに保たれている。従って、この部分を、隙間規制箇所とすることで、隙間規制部材４と現像剤担持体３ａとの隙間は、常に一定にすることが可能になる。

図面では、両磁極がＮ極とＳ極の例が示されているが、その反対であっても、或いは同極同士でも同じである。

また現像剤担持体３ａ上部に複数の磁極を有する構成である場合、隙間規制部材４により隙間が規制される箇所が、現像磁極より現像剤担持体３ａ回転下流側にある最初の磁極と次の磁極の間にあって良い。たとえば、第６図に示すように、現像磁極を１番目として、その下流側に２番目、３番目と磁極が設置されている場合に、隙間規制箇所は、２番目の磁極と３番目の磁極との間にあっても良い。この部分も、前述と同様に、現像剤の層の厚さに、現像剤担持体３ａの磁極による現像剤の暴れの影響がなく、現像剤表面と隙間規制部材４の間隔が一定に保持できるからである。

前記隙間規制部材４の取り付け位置については、第７図に示すように、該隙間規制部材４の先端と現像剤担持体３ａ中心とを結んだ線で分けた感光体１ａ逆側とすると良い。このような取り付け方とすることで、隙間規制部材４に曲げなどの変形を加えることができるようになり、そうすることで、隙間規制部材４自身の剛性がたとえ高くなくても、剛性を高めることができるようになって、安定し

た隙間規制を達成でき、現像剤飛散の低減には極めて有効である。

次に隙間規制部材４による隙間を規制する範囲をどの程度にすべきかを検討したところ、第８図に示すように、現像剤担持体３ａ上部の隙間を規制する幅Ｗ１が、現像剤担持体３ａ上の現像幅Ｗ２以上になるように設定すべきであるとの結論に達した。そのように設定することで、現像剤の飛散が最も多い、現像剤担持体３ａ上部の現像幅Ｗ２の両端を、隙間規制部材４で規制することができるようになり、現像剤の飛散を有効に防止できるようになるからである。

さらに本発明者等は、隙間規制部材４による隙間を規制する部分の形状はどのようにしたら望ましいのかを検討した。そうしたところ、現像器カバー２０３が、熱の影響を受けるなどして変形し、形状的に現像剤担持体３ａ中央に近づく傾向にある場合は、隙間規制部材４の先端形状として、第９図に示すように、現像剤担持体３ａ端部より、その中央部の方が、隙間幅が広くなるようにすることで、その変形を補償することができるようにすると良いということになった。それにより、安定した隙間規制を実現し、現像剤飛散を有効に抑えることができるようになる。

反対に現像器カバー２０３が、同じく変形して、形状的に現像剤担持体３ａ中央から遠ざかる傾向にある場合は、隙間規制部材４の先端形状として、第１０図に示すように、現像剤担持体３ａ端部より、その中央部の方が、隙間幅が狭くなるようにすると良いということになった。それにより、その変形を補償することができるようになり、安定した隙間規制を実現し、現像剤飛散を有効に抑えることができるようになる。

本発明では、前述のように、画像形成装置の構成だけでなく、該装置に使用される現像装置の構成についても提案する。すなわち、当該現像装置の構成は、

静電潜像を担持している感光体との接点又は最接近点で重力に逆らう方向に回転する現像剤担持体と、該現像剤担持体により搬送される現像剤を封入するためのカバーとを備えていて、内部に溜まった現像剤を該現像剤担持体により担持し搬送して、前記感光体上の静電潜像を現像する現像装置であって、

現像剤担持体表面に接触しないように設置され、該現像剤担持体上部側隙間を規制する隙間規制部材を少なくとも有しており、

該現像剤担持体と隙間規制部材との隙間を、前記感光体との接点又は最接近点付近における、現像剤担持体表面より最も高く突出する現像剤の高さ以下に設定することを特徴としている。この構成は、請求の範囲１の構成に対応している。

また現像剤担持体が磁極を有する構成である場合に、隙間規制部材による現像剤担持体との隙間を、隙間が規制される箇所から現像剤担持体回転下流側直後にある磁極での現像剤の磁気ブラシの高さ以下にするようにすると良い。この構成は、請求の範囲２の構成に対応している。

図面の簡単な説明

第１図は、本発明における現像ローラと隙間規制部材との設置状態を示す説明図、第２図は、隙間規制量と現像剤飛散量との相関関係を示すグラフ、第３図は、各磁気ブラシの高さ毎に、隙間幅と現像剤飛散量の測定結果とをまとめたグラフ、第４図は、隙間規制部材を現像ローラ表面にわずかに接触するように設置した状態を示す説明図、第５図は、隙間規制箇所を、現像磁極とその下流側の磁極の間にあるように設定した状態を示す説明図、第６図は、現像磁極を１番目として、その下流側の２番目と、３番目の磁極の間を、隙間規制箇所とした状態を示す説明図、第７図は、隙間規制部材４の取り付け位置が、該隙間規制部材４の先端と現像剤担持体３ａ中心とを結んだ線で分けた感光ドラム１逆側になるようにした構成を示す構成概要図、第８図は、現像剤担持体３ａ上部の隙間規制部材４による隙間を規制する幅Ｗ１が、現像剤担持体３ａの現像幅Ｗ２以上になるように、隙間規制部材４のサイズを設定した状態を示す構成概要図、第９図は、現像剤担持体３ａ上部の隙間幅を規制する隙間規制部材４の先端形状として、現像剤担持体３ａ端部より、その中央部の方が、隙間幅が広くなるように構成されたものを示す構成概要図、第１０図は、現像剤担持体３ａ上部の隙間幅を規制する隙間規制部材４の先端形状として、現像剤担持体３ａ端部より、その中央部の方が、隙間幅が狭くなるように構成されたものを示す構成概要図、第１１図は、発明を実施する形態の一例を示すプリンタ装置概要図、第１２図は、現像器２の斜視図、第１３図は、現像器２及び感光ドラム１との間で現像処理が行われている状

態を示す説明図、第１４図は、従来の構成における現像ローラ３とその上部にある現像器カバー２０３との状態を示す説明図、第１５図は、隙間規制部材４を現像器カバー２０３で構成した本発明の別の実施形態構成を示す説明図、第１６図は、隙間規制部材４と現像器カバー２０３とを同じ材質にした状態を示す説明図、第１７図は、感光体上に形成された可視像を搬送されてきた用紙などに転写する画像形成装置の構成概要図、第１８図は、現像器の現像剤担持体とその上方の蓋の設置状態を示す斜視図、第１９図は、感光体との接点又は最接近点で重力に逆らう方向に回転する現像剤担持体と感光体との組み合わせ例を示す説明図である。

発明を実施するための最良の形態

以下、本発明の実施の形態を図示例と共に説明する。

第１１図は発明を実施する形態の一例であって、電子写真方式を用いたプリンタの構成概要図である。図中、１は感光ドラム、２は現像器、３は現像器内に設けられた現像ローラ、１０１は感光ドラム１に電荷を与えて帯電せしめるコロナ帯電器、１０２は潜像形成のために露光を行うＬＥＤヘッド、１０３は現像されて可視化された感光ドラム１上の像を用紙に転写せしめる転写部、１０４は感光ドラム１上の残留した現像剤を剥離回収するクリーニング部である。尚、同図においてMは、用紙の搬送路を示している。

上記の感光ドラム１は図面上時計回りに回転する。この感光ドラム１の上部にあるコロナ帯電器１０１により、ドラム表面を帯電せしめる。そしてＬＥＤヘッド１０２により、露光を行い、静電潜像を形成する。その後、現像器２の現像ローラ３により、静電潜像に現像剤を付着せしめ、可視像を形成する。その後感光ドラム１上の可視像を転写部１０３において、搬送路Mにより図中矢印方向に搬送されてきた用紙に転写する。この時用紙に転写されなかった現像剤は、クリーニング部１０４において、剥離し回収される。

第１２図は、上記現像器２の斜視図、第１３図は、その現像器２及び感光ドラム１との間で現像処理が行われている状態を示す説明図である。この例では、感

光ドラム１及び現像ローラ３共に、時計回りに回転している。第１３図において右下側より、現像器２内に溜まっており撹拌により帯電された現像剤を、現像ローラ３にて搬送し、現像剤規制ブレード２０１にて、その搬送量をある程度規制する。さらに現像ローラ３にて、感光ドラム１まで搬送される。この時、感光ドラム１上の印字又は画像印刷に使用される潜像部分には、現像剤が付着されて現像が行われる。該現像に使用されなかったものは、現像ローラ３によって、さらに搬送され、現像剤回収ブレード２０２にて、現像ローラ３から掻き取られる。掻き取られた現像剤は、現像器２内に溜まっている現像剤と混合され、撹拌され、帯電される。以上の繰り返しで、感光ドラム１上に画像形成が行われる。

このような現像器２は、一部現像ローラ３が突出し、その他の部分は、樹脂製のカバー２０３で覆われている。各面を形成するカバー２０３は、互いに接続されているが、製造上の都合により、完全に封鎖することはできない。また現像ローラ３の上下部分とカバー２０３との間には、現像ローラ３が回動する際の支障にならない程度の隙間が必要である。

さらに従来の構成では、第１４図に示すように、現像ローラ３とその上部にある現像器２のカバー２０３とは、比較的大きく開いている。これに対し本発明の構成では、第１３図に示すように、現像ローラ３上部の感光ドラム１寄りの方には、隙間規制部材４が設けられており、該隙間規制部材４と現像ローラ３との隙間が規制されることになる。

この隙間の規制量Ｌは、前述の実験結果から、その隙間規制箇所より下流側直後にある磁極での磁気ブラシ高さＴより小さくなるように設定されている。ここでは、該磁気ブラシの高さＴが３．５ｍｍであったのに対し、上記の隙間規制部材４先端部と現像ローラ３との隙間が、３．５ｍｍより小さくなるように、隙間規制部材４の先端部の位置が設定されている。そのため、現像剤飛散量は、第２図に示すように、飛躍的に低減され、第１４図の従来例の場合に比べて、はるかに低減されることとなった。従来例の場合は、前記カバー２０３と現像ローラ３との間が、３．５ｍｍより広くなっている。また現像ローラ３と感光ドラム１との間は、３．５ｍｍの間隔である。尚、この隙間が規制された箇所での現像剤層の厚みは、１．５ｍｍあり、前記隙間幅は、１．５ｍｍより大きく設定されている。これは

、前述のように、隙間規制部材４の先端部が現像剤に接触すると、現像剤溜まりＤができ、感光ドラム１表面に現像剤が付着して、印刷障害とならないようにするためである。

また本実施形態では、第１３図に示すように、現像ローラ３の現像磁極であるＮ極と該現像磁極より現像ローラ３回転下流側の磁極であるＳ極の間に、隙間規制部材４の先端部が位置するように、該隙間規制部材４を設置している。この部分は、前述のように、現像剤の層の厚さに、現像ローラ３の磁極による現像剤の暴れの影響がなく、現像剤表面と隙間規制部材４の間隔が一定になっている。そのため、隙間を規制して、現像器２内に空気を送り込ませないようにするには、最適な場所である。

前記第６図に示すように、現像磁極を１番目として、その下流側に２番目、３番目と磁極が設置されている場合には、隙間規制部材４による隙間規制箇所を、２番目の磁極と３番目の磁極との間にしても良い。この部分も、前述と同様に、現像剤の層の厚さに、現像ローラ３の磁極による現像剤の暴れの影響がなく、現像剤表面と隙間規制部材４の間隔が一定に保持できるからである。

第１５図は、本発明の別の実施形態構成を示している。同図に示すように、隙間規制部材４を現像器２のカバー２０３で構成するようにした。すなわち該カバー２０３の先端部を現像ローラ３側に突出させている。これにより、上記カバー２０３に別体である隙間規制部材４を取り付ける方法ではできなかった、隙間規制部材４の変形を抑えることができ、現像器のカバー２０３全体で、剛性を得ることができ、安定した隙間規制を行うことができ、現像剤飛散低減に大なる影響がある。

第１５図の構成の場合と原理的に同じ構成として、隙間規制部材４の変形を抑えるために、第１６図に示すように、隙間規制部材４と現像器カバー２０３とを同じ材質にすることもできる。同材質にすることで、隙間規制部材４の変形を抑え、安定した隙間規制をすることができるようになり、現像剤飛散低減に役立つことになる。これは、特に、対環境性に影響し、低温時と高温時を繰り返し放置又は使用されると、別の材料を使っている場合の材料の収縮性が異なるため、徐々にストレスが溜まり、変形する。本構成と前記第１５図の構成は、このような

変形を防止するのに、好適な構成である。

また上記カバー２０３の変形が大きな場合に、隙間規制部材４と現像器カバー２０３とを別の材質にすることで、その変形を抑えるようにすることもできる。すなわち、カバー２０３の変形が大きい場合には、変形量の小さい材質のカバー２０３を用いることで、現像器カバー２０３の変形に対し、それを補正するように作用させることができる。それにより安定した隙間規制を達成でき、現像剤飛散を有効に抑止し得る。

隙間規制部材４に別の材質を用いる場合、たとえば、マイラシートを用いることで、マイラシートという柔軟な部材がため、現像器カバー２０３に取り付ける際に、取り付けが容易になり、また取り付け位置や状態の調整も容易になる。もちろん、現像器カバー２０３にもマイラシートを用いて、隙間規制部材４と同材質にすることもできる。

さらに隙間規制部材４にＳＵＳなどの高剛性の部材を用い、上記カバー２０３とは別の材質のものにすることもできる。ＳＵＳのように剛性が高い材質を用いた場合、現像器カバー２０３の変形の影響を受けることがなく、安定した隙間規制を達成でき、現像剤飛散の低減には極めて有効である。もちろん、現像器カバー２０３にもＳＵＳなどの剛性の高いものを用いて、隙間規制部材４と同材質にすることもできる。

前述した第７図に示すように、隙間規制部材４の取り付け位置が、該隙間規制部材４の先端と現像ローラ３中心とを結んだ線で分けた感光ドラム１逆側になるように、該隙間規制部材４を取り付けることで、たとえば、この隙間規制部材４は、同図に示すように、「く」の字型にすることやＬ曲げのような形状にすることができるようになる。そうすることで、隙間規制部材４自身の剛性がたとえ高くなくても、剛性を高めることができるようになり、ＳＵＳなどの剛性の高い材質のものを用いた場合と同様、安定した隙間規制を達成でき、現像剤飛散の低減には極めて有効である。

さらに前記第８図に示すように、現像ローラ３上部の隙間規制部材４による隙間を規制する幅Ｗ１が、現像ローラ３の現像幅Ｗ２以上になるように、隙間規制部材４のサイズを設定する。これは、現像剤の飛散する場所として、現像ローラ

３上部の現像幅Ｗ２の両端が多いためであり、隙間規制部材４でこの両端を規制することで、現像剤飛散を低減できるからである。従ってこの構成は、これまでのどの実施形態構成にも共通して用いることができるものである。

また、前記第９図のように、現像ローラ３上部の隙間幅を規制する隙間規制部材４の先端形状として、現像ローラ３端部より、その中央部の方が、隙間幅が広くなるように構成すべき場合がある。これは、現像器カバー２０３が、熱の影響を受けるなどして変形することを予測し、設定されるものである。すなわち、現像器カバー２０３が、変形により形状的に現像ローラ３中央に近づく傾向にある場合に、このような構成とし、それにより、安定した隙間規制を実現し、現像剤飛散を有効に抑えるものである。

また前記第１０図に示すように、現像ローラ３上部の隙間幅を規制する隙間規制部材４の先端形状として、現像ローラ３端部より、その中央部の方が、隙間幅が狭くなるように設計されるものもある。この構成も、現像器カバー２０３が、熱の影響を受けるなどして変形することを予測し、設定している。すなわち、現像器カバー２０３が、形状的に現像ローラ３中央から離れる傾向にある場合に、このような構成とし、それにより、安定した隙間規制を実現し、現像剤飛散を有効に抑えるものである。

第９図の構成と第１０図の構成は、現像器カバー２０３の変形が全く反対の場合の構成を前提としているが、いずれも、熱などの影響を受けた場合に変形が大きくなる場合の構成であり、材質によって、引っ張り強度などに異方性を生じるので、どの方向の変形が著しくなるかを見極めて設定する必要がある。

尚、本発明の画像形成装置は、上述の実施例にのみ限定されるものではなく、本発明の要旨を逸脱しない範囲内において種々変更を加え得ることは勿論である。

以上、説明したように本発明の画像形成装置の構成によれば、現像剤担持体上方に、該現像剤担持体表面との間にできる隙間を規制できる隙間規制部材を用いる場合に、これまで知られていなかった隙間規制幅を所定の範囲内に設定することで、現像器からの現像剤の飛散が極めて低くなるといった優れた効果が得られるようになる。

また、隙間規制部材により隙間が規制される箇所が、現像磁極と、その現像磁極より現像剤担持体回転下流側の磁極の間にあるように設定することで、現像剤の暴れの影響がなく、現像剤表面と隙間規制部材の間隔が一定になる部分で隙間規制が行われるようになるため、現像剤飛散の低減に効果的である。

さらに、隙間規制部材による現像剤担持体上部の隙間を規制する幅を、現像剤担持体上の現像幅以上にすることで、現像剤の飛散が最も多い、現像剤担持体上部の現像幅の両端を、隙間規制部材で規制することができるようになり、現像剤の飛散を有効に防止できるようになる。

産業上の利用可能性

以上のように、本発明に係る画像形成装置及び現像装置は、電子写真方式を用いた、複写機、ファクシミリ、プリンタ、その他の情報処理システムなどの画像形成を行う装置において、現像剤の飛散を防止する構成として有用であり、特に現像器内の現像剤担持体が感光体との接点又は最接近点で重力に逆らう方向に回転する構成の場合に問題となっていた、現像器内に空気を送り込むことを防ぐのに適している。

請　求　の　範　囲

1．　静電潜像を担持している感光体と、

前記感光体との接点又は最接近点で重力に逆らう方向に回転する現像剤担持体と、該現像剤担持体により搬送される現像剤を封入するためのカバーとを備えていて、内部に溜まった現像剤を該現像剤担持体により担持し搬送して、前記感光体上の静電潜像を現像する現像手段と、

現像剤担持体表面に接触しないように設置され、該現像剤担持体上部側隙間を規制する隙間規制部材とを少なくとも有しており、

該現像剤担持体と隙間規制部材との隙間を、感光体との接点又は最接近点付近における、現像剤担持体表面より最も高く突出する現像剤の高さ以下に設定することを特徴とする画像形成装置。

2．　現像剤担持体が磁極を有する構成である場合に、隙間規制部材による現像剤担持体との隙間を、隙間が規制される箇所から現像剤担持体回転下流側直後にある磁極での現像剤の磁気ブラシの高さ以下にすることを特徴とする請求の範囲1記載の画像形成装置。

3．　前記隙間規制部材による現像剤担持体との隙間を、現像剤担持体と感光体とのギャップ以下にすることを特徴とする請求の範囲1記載の画像形成装置。

4．　現像剤担持体が磁極を有する構成である場合に、隙間規制部材により隙間が規制される箇所が、現像磁極と、その現像磁極より現像剤担持体回転下流側の磁極の間にあることを特徴とする請求の範囲1～3のいずれか1つに記載の画像形成装置。

5．　前記隙間規制部材による現像剤担持体上部の隙間を規制する幅が、現像剤担持体上の現像幅以上であることを特徴とする請求の範囲1～4のいずれか1つに記載の画像形成装置。

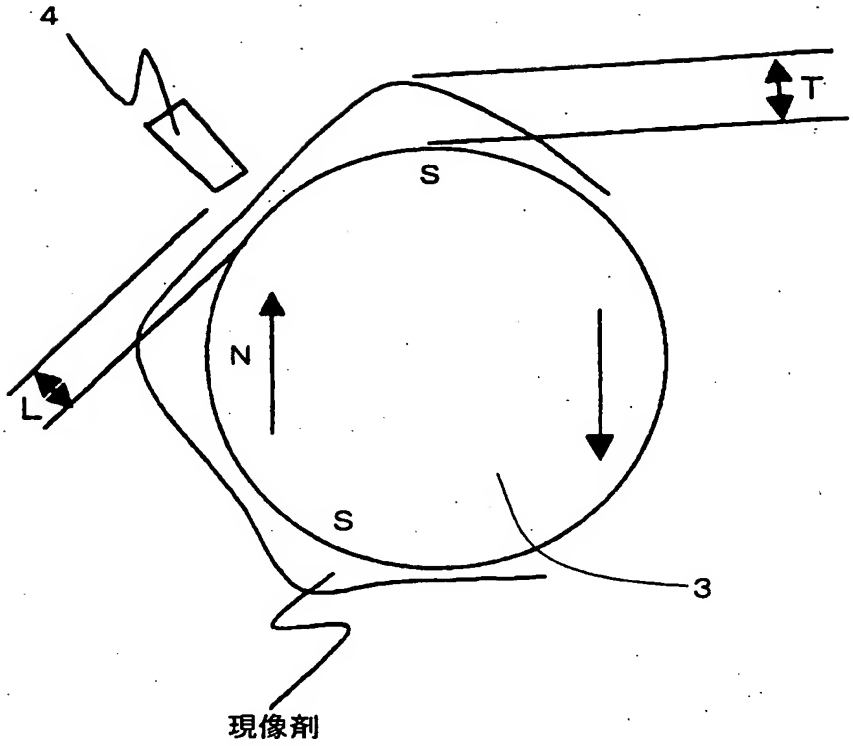
6．　静電潜像を担持している感光体との接点又は最接近点で重力に逆らう方向に回転する現像剤担持体と、該現像剤担持体により搬送される現像剤を封入するためのカバーとを備えていて、内部に溜まった現像剤を該現像剤担持体により担持し搬送して、前記感光体上の静電潜像を現像する現像装置であって、

現像剤担持体表面に接触しないように設置され、該現像剤担持体上部側隙間を規制する隙間規制部材を少なくとも有しており、

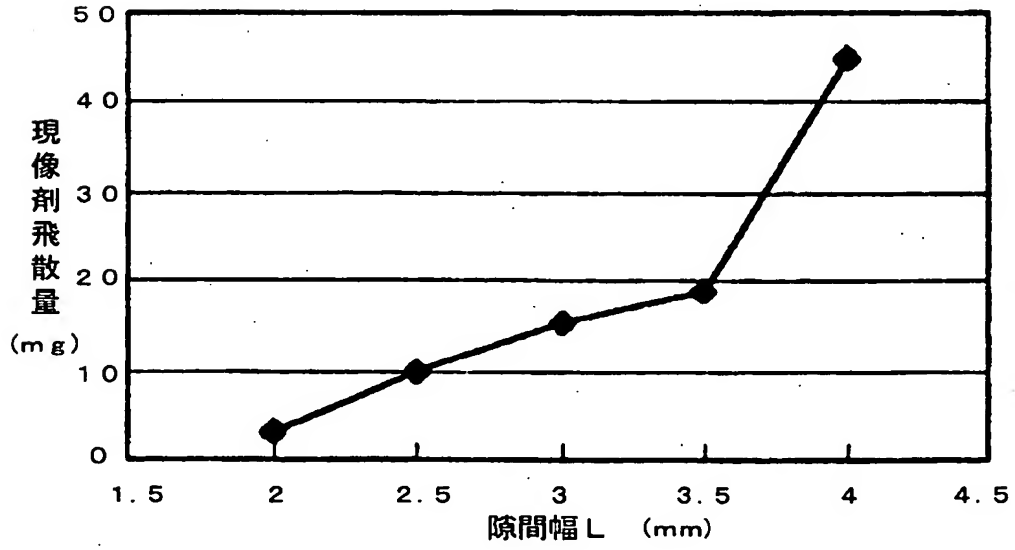
該現像剤担持体と隙間規制部材との隙間を、前記感光体との接点又は最接近点付近における、現像剤担持体表面より最も高く突出する現像剤の高さ以下に設定することを特徴とする現像装置。

７．　現像剤担持体が磁極を有する構成である場合に、隙間規制部材による現像剤担持体との隙間を、隙間が規制される箇所から現像剤担持体回転下流側直後にある磁極での現像剤の磁気ブラシの高さ以下にすることを特徴とする請求の範囲６記載の現像装置。

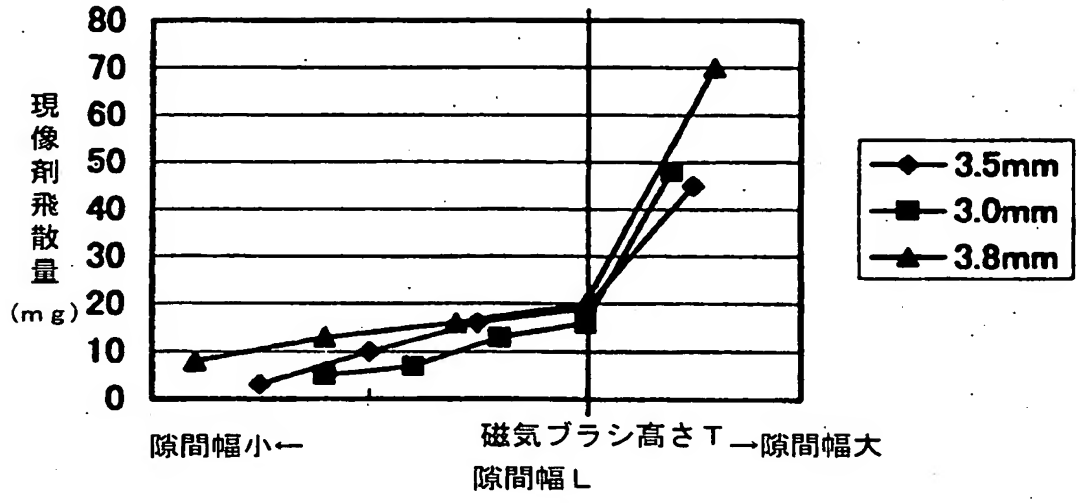
第１図



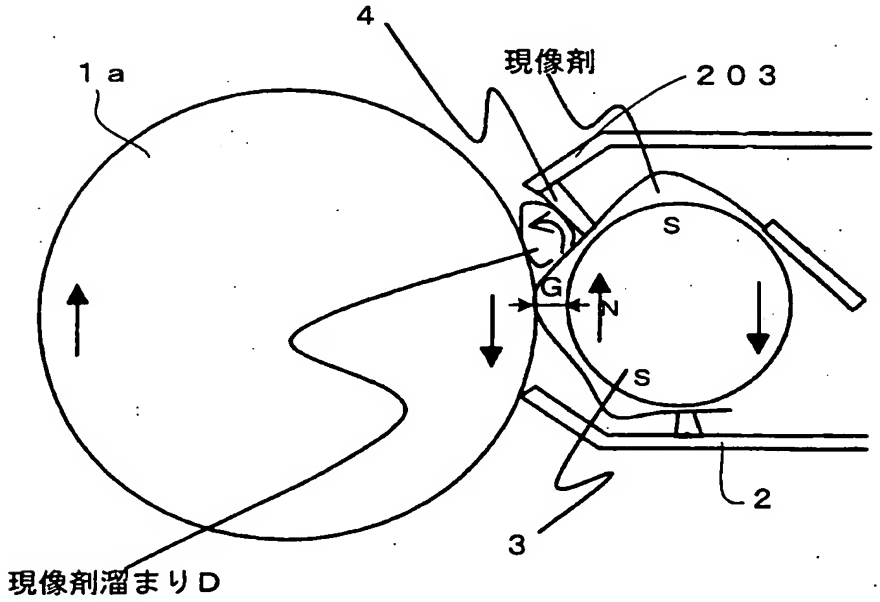
第２図



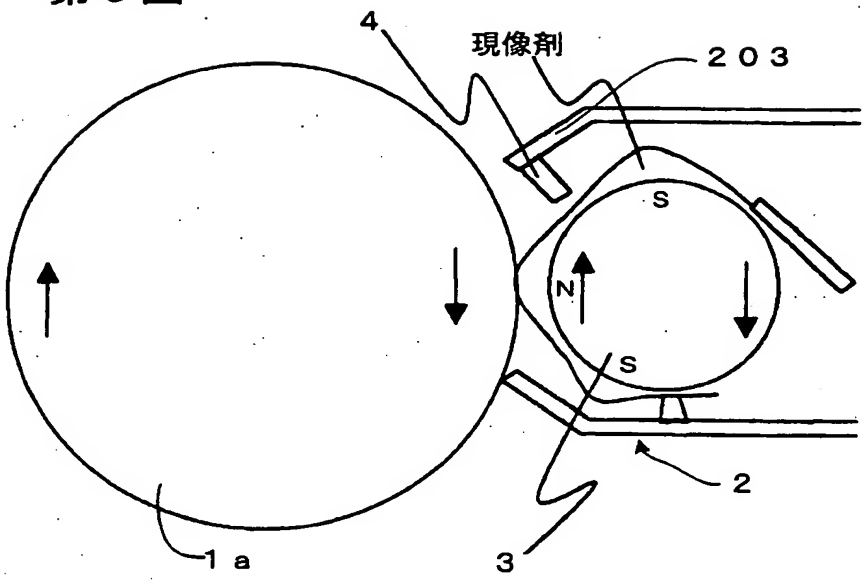
第３図


80
70
60
50
40
30
20
10
0
現像剤飛散量
(mg)
3.5mm
3.0mm
3.8mm
隙間幅小←
磁気ブラシ高さＴ→隙間幅大
隙間幅Ｌ

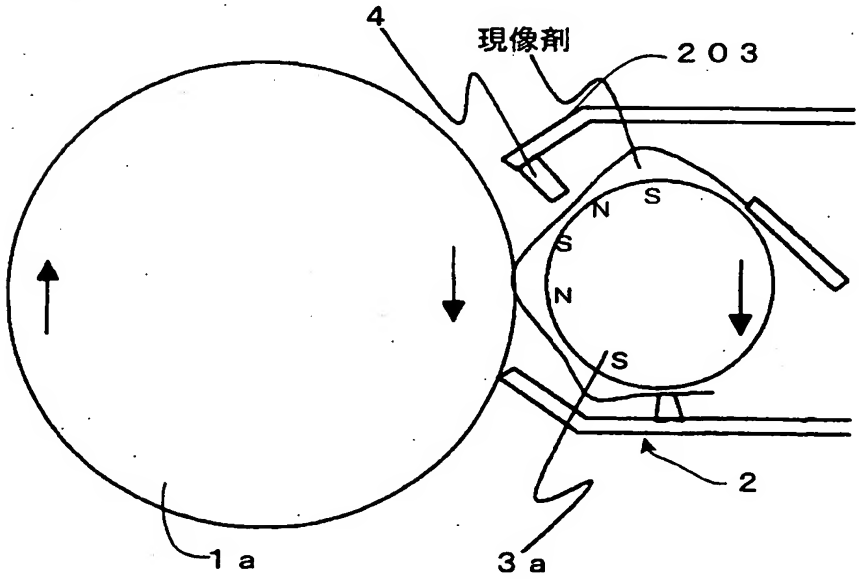
第４図


4
現像剤
２０３
１ａ
S
G
N
S
2
3
現像剤溜まりＤ

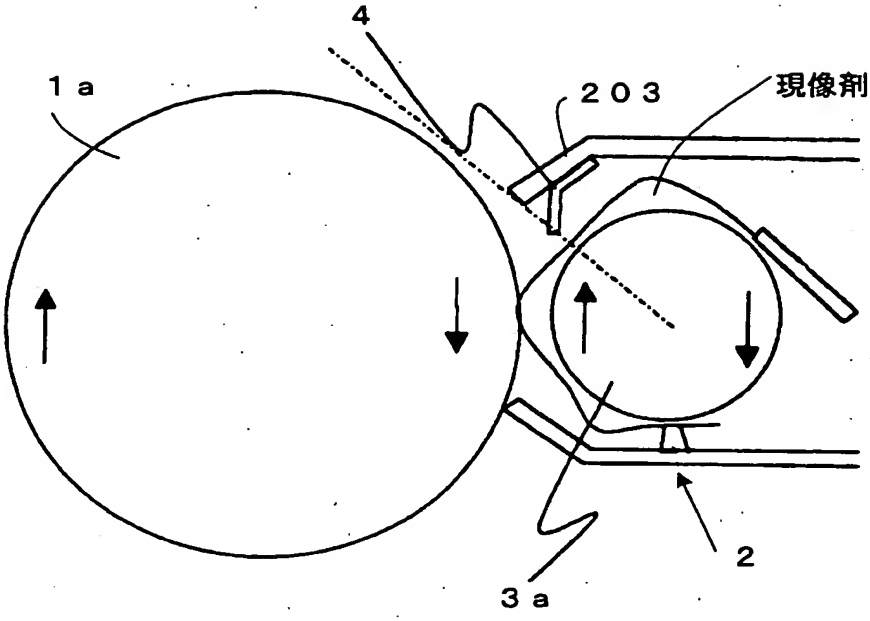
第５図



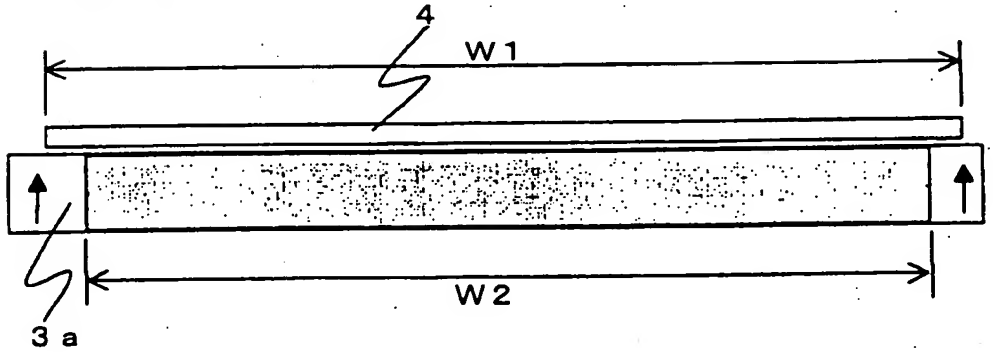
第６図



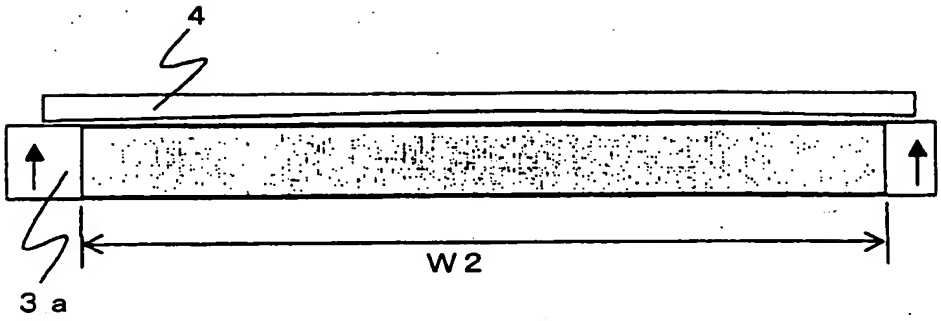
第７図



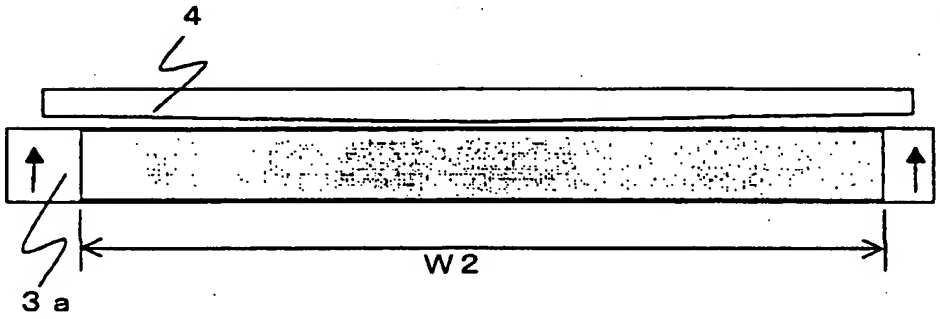
第８図



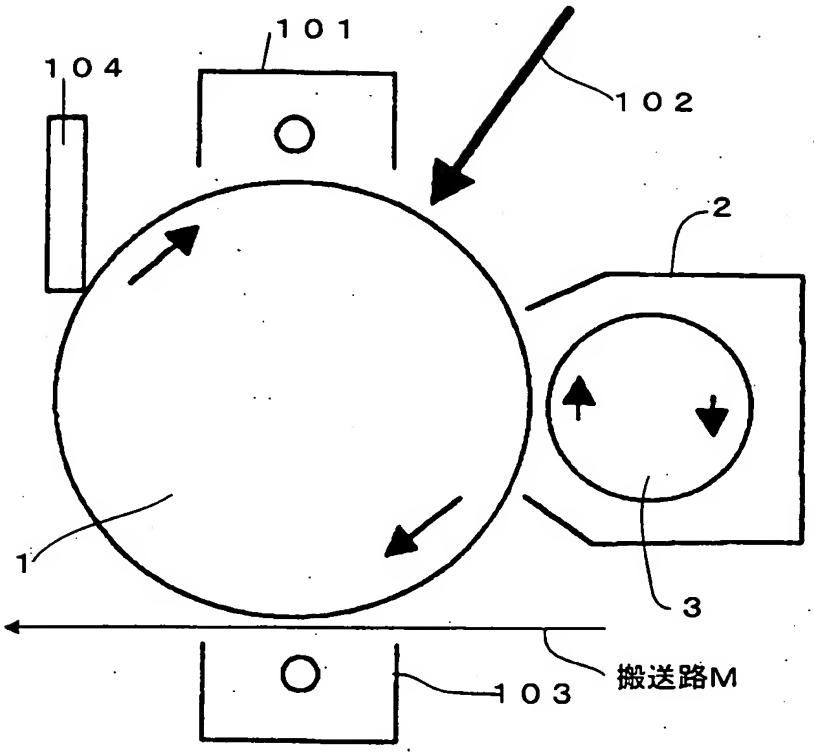
第９図



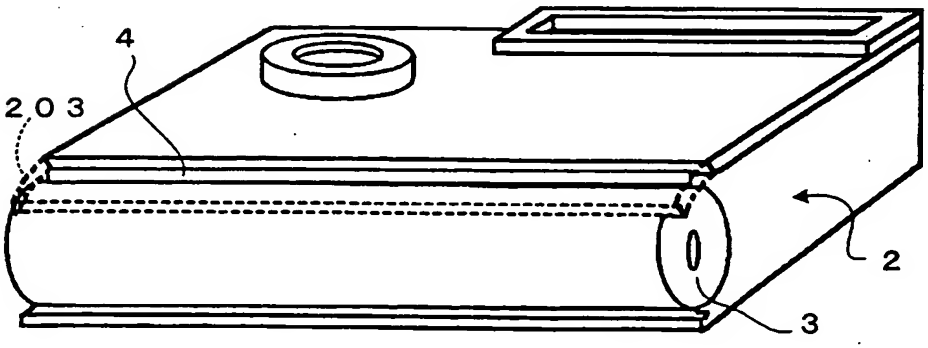
第１０図



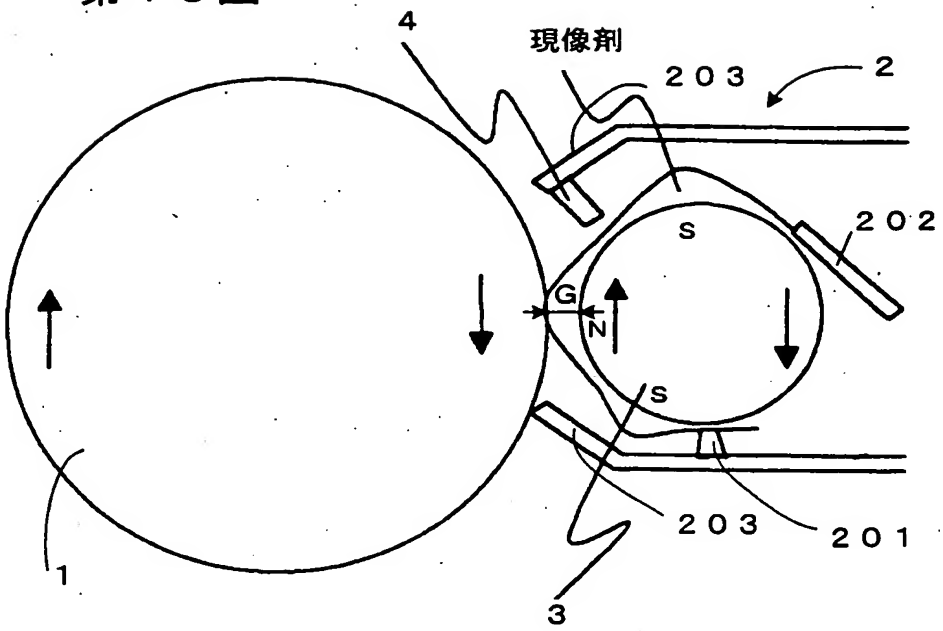
第１１図



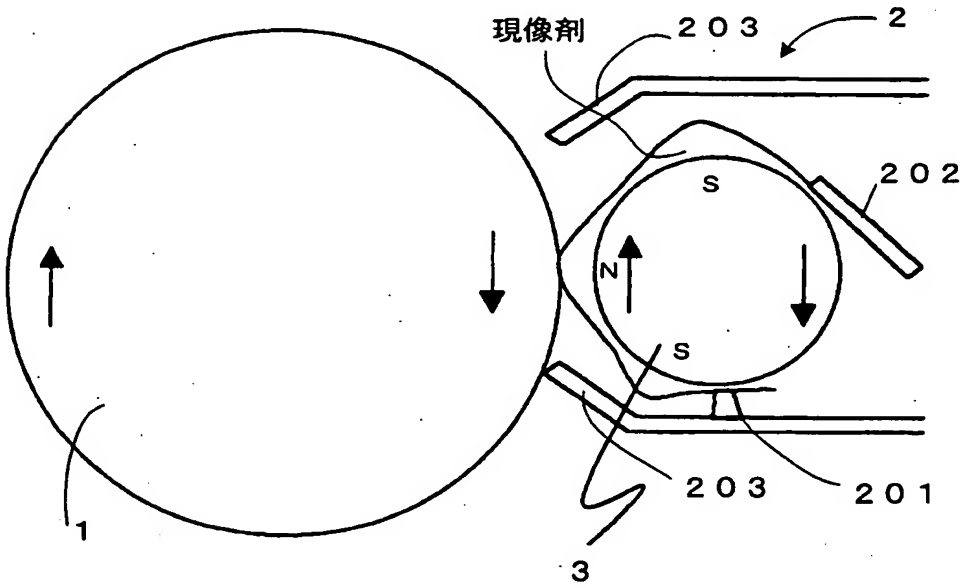
第１２図



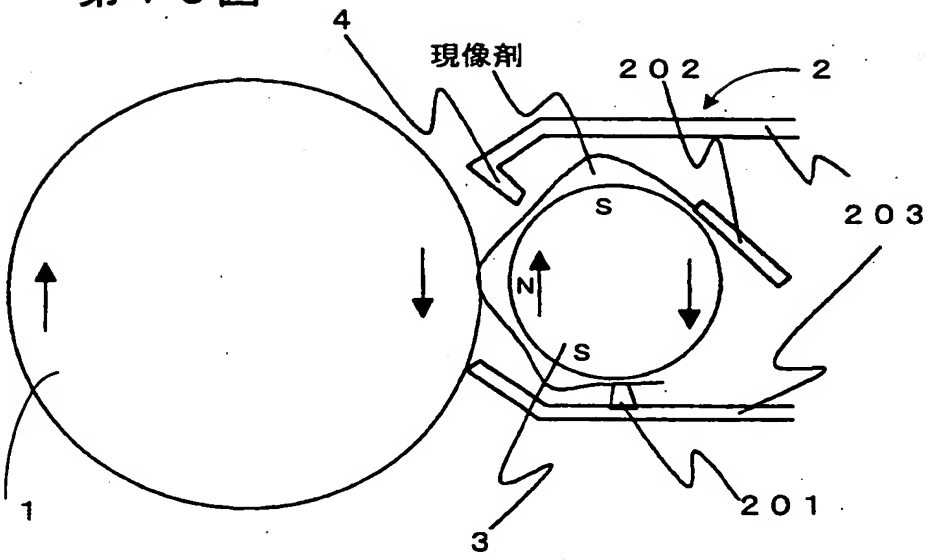
第１３図



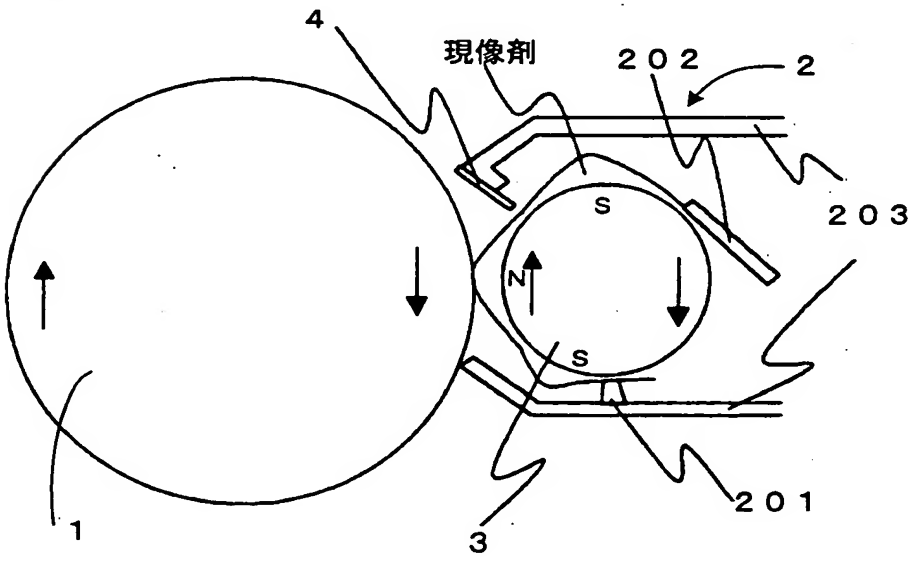
第１４図



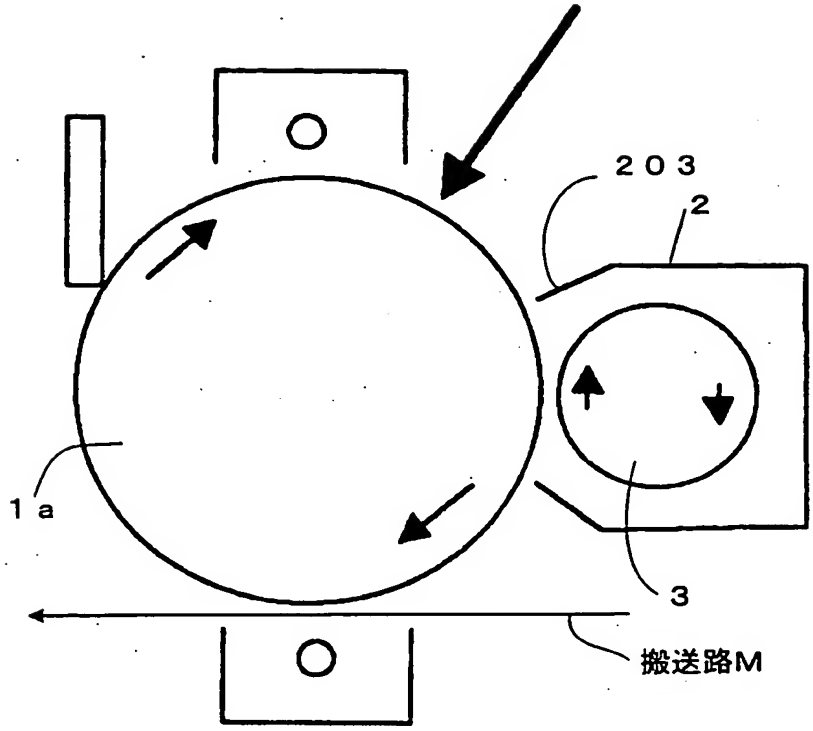
第１５図



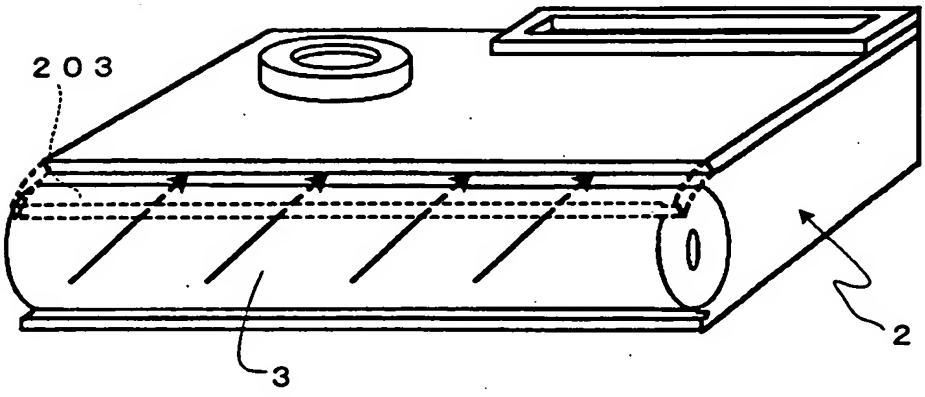
第１６図



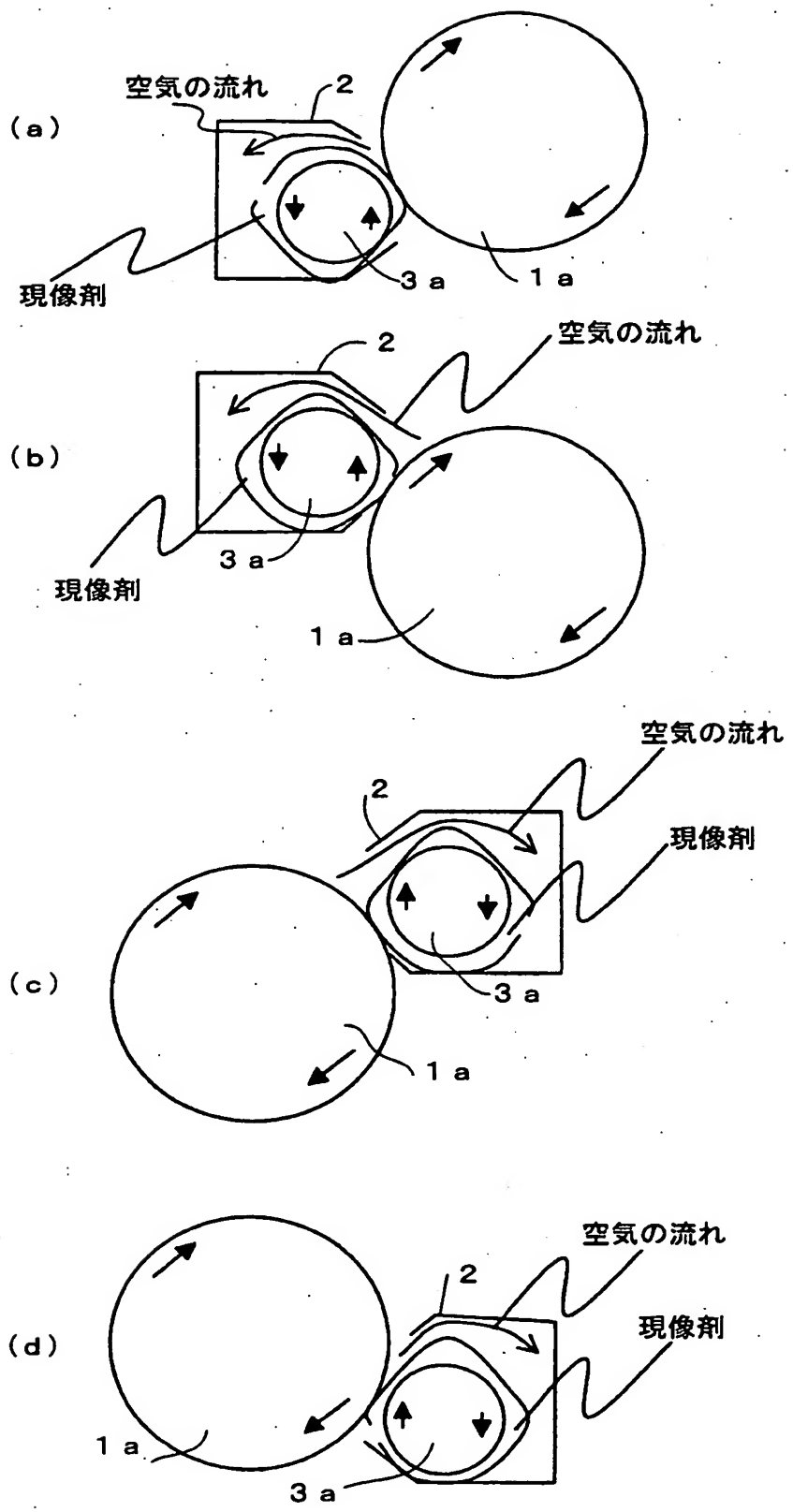
第１７図



第１８図



第１９図


(a)
空気の流れ
2
現像剤
3a
1a
(b)
2
空気の流れ
現像剤
3a
1a
(c)
空気の流れ
2
現像剤
3a
1a
(d)
空気の流れ
2
現像剤
1a
3a

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/03946

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] G03G15/09

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] G03G15/08-15/095

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 52-50243, A (Fuji Xerox Co., Ltd.), 22 April, 1977 (22. 04. 77), Page 2, upper left column, line 19 to lower right column, line 15 ; Fig. 3 (Family: none)	1-7
Y	JP, 56-99364, A (Olympus Optical Co., Ltd.), 10 August, 1981 (10. 08. 81), Page 2, lower right column, line 19 to page 5, upper right column, line 8 ; all drawings & US, 4377334, A	1-7
Y	JP, 4-264473, A (Ricoh Co., Ltd.), 21 September, 1992 (21. 09. 92), Page 3, column 3, lines 15 to 20 ; page 4, column 5, line 50 to column 6, line 31 ; Figs. 1, 3 (Family: none)	1-4, 6, 7

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 August, 1999 (10. 08. 99)	17 August, 1999 (17. 08. 99)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/03946

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 59-111790 (Laid-open No. 61-27152) (Ricoh Co., Ltd.), 18 February, 1986 (18. 02. 86), Full text ; all drawings (Family: none)	1-4, 6
Y	JP, 63-311284, A (Ricoh Co., Ltd.), 20 December, 1988 (20. 12. 88), Page 3, upper left column, line 3 to lower left column, line 1 ; page 4, upper left column, line 10 to upper right column, line 7 ; Figs. 2, 4 (Family: none)	1-2, 5-7
Y	JP, 1-102588, A (Hitachi Metals,Ltd.), 20 April, 1989 (20. 04. 89), Page 5, upper right column, lines 9, 10 ; Fig. 1 (Family: none)	1, 2, 4, 6
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 60-165043 (Laid-open No. 62-74256) (Ricoh Co., Ltd.), 12 May, 1987 (12. 05. 87), Page 5, line 11 to page 7, line 5 ; Fig. 1 (Family: none)	1, 2, 4, 6
Y	JP, 4-307572, A (Canon Inc.), 29 October, 1992 (29. 10. 92), Page 3, column 3, line 46 to page 6, column 9, line 33 ; Figs. 1 to 5 (Family: none)	1, 2, 4-7
Y	JP, 4-281480, A (Mita Industrial Co., Ltd.), 7 October, 1992 (07. 10. 92), Page 4, column 6, line 18 to page 5, column 7, line 47 ; all drawings (Family: none)	5

国際調査報告

国際出願番号　PCT／JP99／03946

A.　発明の属する分野の分類（国際特許分類（IPC））

Int. Cl.⁶　G03G15／09

B.　調査を行った分野

調査を行った最小限資料（国際特許分類（IPC））

Int. Cl.⁶　G03G15／08 － 15／095

最小限資料以外の資料で調査を行った分野に含まれるもの

日本国実用新案公報	1926－1996
日本国公開実用新案公報	1971－1999
日本国登録実用新案公報	1994－1999
日本国実用新案登録公報	1996－1999

国際調査で使用した電子データベース（データベースの名称、調査に使用した用語）

C.　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Y	JP，52－50243，A（富士ゼロックス株式会社），22．4月．1977（22．04．77）第2頁左上欄第19行～第2頁右下欄第15行、第3図（ファミリーなし）	1－7
Y	JP，56－99364，A（オリンパス光学工業株式会社），10．8月．1981（10．08．81）第2頁右下欄第19行～第5頁右上欄第8行、全図&US，4377334，A	1－7

☒ C欄の続きにも文献が列挙されている。　☐ パテントファミリーに関する別紙を参照。

＊ 引用文献のカテゴリー
「A」特に関連のある文献ではなく、一般的技術水準を示すもの
「E」国際出願日前の出願または特許であるが、国際出願日以後に公表されたもの
「L」優先権主張に疑義を提起する文献又は他の文献の発行日若しくは他の特別な理由を確立するために引用する文献（理由を付す）
「O」口頭による開示、使用、展示等に言及する文献
「P」国際出願日前で、かつ優先権の主張の基礎となる出願の日の後に公表された文献
「T」国際出願日又は優先日後に公表された文献であって出願と矛盾するものではなく、発明の原理又は理論の理解のために引用するもの
「X」特に関連のある文献であって、当該文献のみで発明の新規性又は進歩性がないと考えられるもの
「Y」特に関連のある文献であって、当該文献と他の1以上の文献との、当業者にとって自明である組合せによって進歩性がないと考えられるもの
「&」同一パテントファミリー文献

国際調査を完了した日　10．08．99	国際調査報告の発送日　17.08.99
国際調査機関の名称及びあて先 日本国特許庁（ISA／JP） 郵便番号100－8915 東京都千代田区霞が関三丁目4番3号	特許庁審査官（権限のある職員）　2C　8004 小牧　修 電話番号　03－3581－1101　内線　3221

様式PCT／ISA／210（第2ページ）（1998年7月）

国際調査報告	国際出願番号　PCT／JP99／03946

C（続き）．　関連すると認められる文献

引用文献のカテゴリー＊	引用文献名　及び一部の箇所が関連するときは、その関連する箇所の表示	関連する請求の範囲の番号
Y	JP，4－264473，A（株式会社リコー）21．9月．1992（21．09．92）第3頁第3欄第15～20行，第4頁第5欄第50行～同頁第6欄第31行，図1，図3（ファミリーなし）	1－4，6，7
Y	日本国実用新案登録出願59－111790号（日本国実用新案登録出願公開61－27152号）の願書に添付した明細書及び図面の内容を撮影したマイクロフィルム（株式会社リコー）18．2月．1986（18．02．86）全文，全図（ファミリーなし）	1－4，6
Y	JP，63－311284，A（株式会社リコー）20．12月．1988（20．12．88）第3頁左上欄第3行～同頁左下欄第1行，第4頁左上欄第10行～同頁右上欄第7行，第2図，第4図（ファミリーなし）	1-2，5-7
Y	JP，1－102588，A（日立金属株式会社）20．4月．1989（20．04．89）第5頁右上欄第9～10行，第1図（ファミリーなし）	1，2，4，6
Y	日本国実用新案登録出願60－165043号（日本国実用新案登録出願公開62－74256号）の願書に添付した明細書及び図面の内容を撮影したマイクロフィルム（株式会社リコー）12．5月．1987（12．05．87）第5頁第11行～第7頁第5行，第1図（ファミリーなし）	1，2，4，6
Y	JP，4－307572，A（キャノン株式会社）29．10月．1992（29．10．92）第3頁第3欄第46行～第6頁第9欄第33行，第1－5図（ファミリーなし）	1，2，4-7
Y	JP，4－281480，A（三田工業株式会社）7．10月．1992（07．10．92）第4頁第6欄第18行～第5頁第7欄第47行，全図（ファミリーなし）	5